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West Europe Report

SCIENCE AND TECHNOLOGY

No. 76

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WEST EUROPE REPORT

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No. 76

CONTENTS

[III - WE - 151 S&T]

BRIEFS

GENETIC RESEARCH--"Inmunologia y Genetica Aplicada SA" has been established with headquarters in Barcelona. The firm's purpose is applied research in the field of genetic technology for application in veterinary medicine. Methods developed by the Center for Molecular Biology at the University of Madrid will be converted to practice. Majority participation (51 percent) in Ingenasa is by Initec, the Engineering firm of the government Industrial Holding Authority (INI). The remaining shares (49 percent) are held by "Laboratorios Sobrina SA," Olot/Prov. Gerona, a manufacturer of veterinary medicines. [Text] [Duesseldorf CHEMISCHE INDUSTRIE in German Jul 81 p 396] 9160

CSO: 3102/403

ELECTRONICS

SAAB-SCANIA EUROPEAN LEADER IN CHIP-CARRIER METHOD

Background

Stockholm NY TEKNIK in Swedish 16 Jul 81 p 6

[Article by Ulla Karlsson]

[Text] First in Europe. Saab-Scania was the first to invest in a new technology to reduce the size of and put together the smallest components in electronic equipment: the chip. The method is called chip-carrier and it permits an 80 percent decrease in the surface area of integrated circuits compared with circuits used today. The great breakthrough for the method in the United States is expected next year. So far it has been used mostly for military and space technology.

Integrated circuit technology is being developed constantly to create more compact components and more complex circuits. Along with this comes an increase in the number of input and output terminals. The so-called DIP's, which chips are mounted in today, will also have more leads in the form of small pins. As the number of pins increases, the size of the package also increases. In the end, it is too large to be of practical use.

Completely New Method

Technicians at Saab-Scania's microelectronics division recognized this problem at an early stage. As a result, the company invested in a completely new ceramic packing method--the chip carrier. When this method is used, the size of an installed chip can be reduced considerably.

The volume is reduced by 90 percent and the surface by up to 80 percent.

"The present trend toward more and more compact circuits will also lead to the success of the chip-carrier method," said Hans Danielson, head of the microelectronics division.

Only Possibility

"If a circuit has more than 64 input and output terminals for signals, the chip-carrier is the only practical possibility."

"With the normal DIP a circuit with, for example, 100 pins would be 25 cm long. If a chip-carrier is used, on the other hand, the circuit is only 25 x 25 mm."

"The great breakthrough for this method will probably come in 1982," said Mats Grondahl, chief of marketing for the microelectronics division.

"At that time Texas Instruments will publish results from its work on developing production equipment for the chip-carrier method. The results must be made public since the development work was funded by the American government.

First In Europe

In Europe, Saab-Scania was the first to invest in the chip-carrier. That was in 1978. At that time, technicians at the company were studying how the advanced circuits needed in the Swedish military computer Dator 80 could be produced. They concluded that this was possible only with the chip-carrier.

The result was that Forsvarets Materielverk invested money so that Saab-Scania could begin using this technology. Thus, Saab-Scania became the fourth company in the world to invest in the chip-carrier method.

Withstand High Power

Chips encapsulated by the chip-carrier method are then mounted on a printed board made of a thick film (see separate article).

"Thick-film circuits have many advantages over ordinary integrated circuits," Hans Danielson said. "For example, they can withstand considerably higher power. Our ceramic modules can withstand up to 200 W."

"The heat generated is simply removed by the ceramic material. The ceramic material has a conductivity that is 130 times greater than the epoxy laminate used in ordinary printed circuit boards."

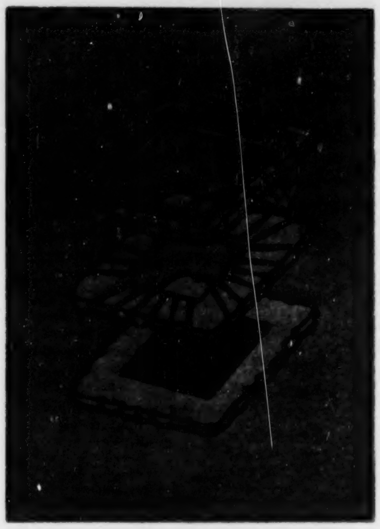
Thick Film Reliable

Thick-film circuits are also considered to be extremely reliable. With this technology, the number of connections on a printed circuit card is reduced, which is important for reliability. It was for this reason, for example, that 2,000 circuits in the space shuttle Columbia were made of thick film.

Saab-Scania is presently one of the European leaders in thick-film technology. With the new chip-carrier method, the company sees a bright future for the microelectronics division.

Sales are expected to increase by an average of 33 percent annually through 1985. Sales in 1981 are expected to reach at least 15 million kronor.

At present, around 15,000 complex thick-film circuits are produced annually. Fifty percent of them are used for the company's own work.



Contacts All Round

Here is how a chip is mounted with the chip-carrier method:

On the bottom is a ceramic plate with a metal pattern on which the chip (circuit) is located. On top of that is laid another ceramic plate with the conductive pattern and external contacts. The contacts are located on all four sides of the circuit (as opposed to only two sides in DIP encapsulation). Before the third and last plate is put on, the chip is affixed--bonded--to the conductive pattern. The upper plate acts as a lid for the circuit. Then the plates are sintered together at 1600-1700°C. The mounted circuit's terminals are soldered (like the DIP capsule's pins) to the tracks of the pattern card.

Thick-Film Technique

Stockholm NY TEKNIK in Swedish 16 Jul 81 p 6

[Text] When a thick-film circuit is to be produced, a graphic model is first made to show how the circuit will be constructed. Today the model is made by computer-aided design--CAD. The result is a photographic background.

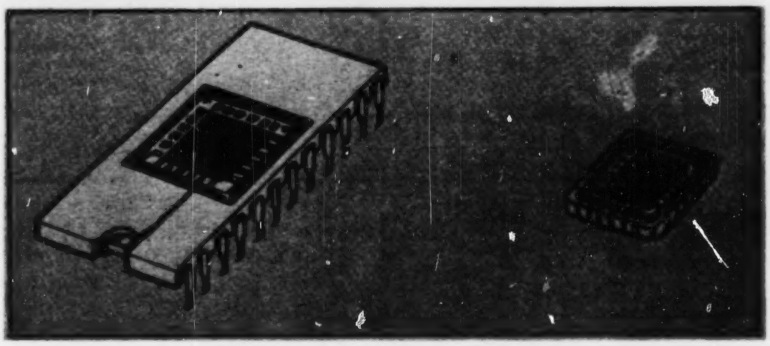
The photographic background is used to produce the stencil that is used in printing. The stencil consists of a fine-meshed steel cloth on which certain portions are clogged, while others are permeable to a film paste. The permeable portions of the stencil form the pattern to be printed. Most often a conductive pattern is used, but resisters and capacitors are also made of thick film. The pattern is then printed on a substrate--a thin plate of ceramic material. This is done by pressing the paste through the stencil down onto the substrate. The pattern formed in this way is first dried in a furnace at about 100 to 150°C. It is then burned on (sintered) in a furnace at 850 to 950 degrees. If an additional pattern is desired the procedure is repeated, but with another paste and another stencil. When the substrate

is ready, the active components are attached--they are seldom made of thick film. (Active components are components that process signals in some way, for example amplify them). They are most often integrated circuits.

If the active component is not already encapsulated, the chip is cemented to the substrate. Thereafter, it is connected electrically by attaching gold wire to the chip and to the conductive pattern--the chip is bonded.

When all the components are attached the substrate is encapsulated and the circuit is ready.

Thick film means that the thickness of the paste (film) on the board is about 10 micrometers. On thin film circuits the film is about 0.1 micrometer thick. Thick-film technology is simpler than thin film technology.



Here is the size difference between a chip (circuit) mounted on a so-called DIP (left) and by the chip-carrier method (right). The more terminals required by the circuit, the greater the difference will be.

9336
CSO: 3102/395

STUDIES SHOW SHALE BEST SOURCE OF METHANOL

Stockholm NY TEKNIK in Swedish 25 Jun 81 p 3

[Article by Hans Wener: "Peat and Biomass Are Elminated; Shale Is Best for Obtaining Methanol"]

> [Text] It is evident now that we are going to obtain from 100 to 125 thousand tons of methanol per million tons of Swedish shale. That is definitely cheaper than if it is produced from peat or biomass.
>
> Tests with gas produced from shale for the Inred process are to be carried out in Lulea during February and March 1982.

"We have a very promising research and development program under way at the installations in Ransted," says the director of the ASA (AB Svensk alunskifferutveckling), Owe Carlsson. "We have been gasifying 5 tons of shale per 24 hours in a fluid bed. That method is almost ready for large-scale use and it provides methanol or ammonia as a final product," he says.

Shale from Narke Is the Richest

With shale from Vastergotland as the raw material, the method produces approximately 100,000 tons of methanol per milllion tons of shale. If one uses shale from Narke, the yield is about 125,000 tons per million tons of shale.

The process produces coke residue which contains approximately 25 percent of the shale's thermal value. How that residue is to be utilized is still to be determined. "It will probably be burned to provide heat for the process and to deliver district heating," Owe Carlsson says.

A competing, or possibly a supplementary, process is the Inred process, which is a process involving the direct reduction of iron ore. Experiments in which one obtains gas from shale for the Inred process are to be carried out in Lulea in February and March. At these higher temperatures, the residues are more glasslike.

The ASA is owned by the LKAB Mining Company and Boliden, which are nationalized enterprises. Last year the company approached the government with a request for

for funds (approximately 100 million kronor) for further development work. The application has been pigeonholed in the Chancellory for the time being, most probably until it has been determined whether one or both of the two methods is good enough to be put into full-scale operation.

Shale Is Best for Obtaining Methanol

"There is no doubt that, by comparison with peat, biomass or residual oil, shale is the best raw material for obtaining methanol," Owe Carlsson believes.

Now 3 years of continued development work in Ranstad are required. Shale from Narke has also been tested there with good results.

In summary, Owe Carlsson says: "A decision to carry out a large-scale operation which makes use of shale should be made in the middle of the 1980's."

The process which is being tested at Ranstad was developed by research carried out under the leadership of Prof Ingem Bjerle at the university of technology in Lund. The research workers concentrated on shale gasification, but not at that location.

Direct gasification of that type was tried out in the field shortly after World War II in Kvarntorp, but without a great deal of success. At that time--during the war--they produced oil from Narke shale. At least enough of it was obtained for the distillation ovens of that time to keep the Swedish submarine fleet going.

Patents to the United State

The nationalized enterprise also owns Svenska skifferolje AB, which operated the Kvarntorp plant. Since 1965, that company has been in the process of being liquidated. According to Director Olle Uddgren, all the remaining work which is to be performed by that plant will be completed during the 1980's.

He says that in 1969 and 1970 the company was reminded by the Ministry of Economy that it was to return the Kvarntorp concession.

The company had collaborated on that concession with two American oil companies in regard to certain patents, on which half of the expenses had been paid by Swedes. Since Swedish interest in shale did not exist (before the shocking increases in the price of oil), those patents were later turned over to the American companies.

Gasification of shale in a fluid bed produces synthesis gas. In addition, tars and gaseous hydrocarbons such as ethers, etc., are formed.

Methanol can be produced from synthesis gas by some type of reforming to get rid of the methane. That is followed by a stage involving the varying of the gas to get the right hydrogen content (proportion of H to CO).

When gasification is accomplished at higher temperatures--as will be considered for the tests with the Inred process next year--the slag melts. One also obtains a better synthesis gas. It becomes pure CO and H.

9266
CSO: 3102/384

NEW SOLAR HEAT STORAGE METHOD: BOREHOLES IN BEDROCK

Helsinki HUFVUDSTADSBLADET in Swedish 15 Jul 81 p 9

[Article by Monica Giselson: "An Interesting Project--Boreholes in Bedrock Constitute a New Heat Storage Method"]

> [Text] Stockholm (FLT)--The latest technique for storing heat over rather long periods of time consists of boring holes in bedrock, filling the holes with circulating hot water and heating the rock in that manner. Furthermore, it is a technique which makes it possible to make better use of solar heat, above all, but also perhaps of waste heat.

"It is a promising method, both technically and economically," says Sven-Erik Lundin of the Construction Research Council of Sweden. "Storage techniques which have been tried in the past have proved to be tremendously expensive. The borehole method should reduce storage costs by at least a third," he says.

Large Storage Spaces Are the Most Economical

Since industry's interest in solar energy and waste heat has increased, the need to hit upon inexpensive storage possibilities has also increased. To make use of energy as effectively as possible, large storage spaces are required where one can store heat on a seasonal basis, from summer to winter. That is also true of the utilization of the natural solar heat from lakes, bays and inlets.

There are several types of seasonal storage spaces. For example, hot water is stored in large concrete or sheetmetal tanks. Storage spaces in the rock, underwater storage spaces and aquifers are other variants. An aquifer is a natural collection of ground water which can be found in loose types of soil.

"But interest and research are now directed toward storage in bedrock," says Sven-Erik Lundin. "The geological conditions in Sweden are quite suitable for it, and from the economical point of view the borehole method should work out well," he says.

Approximately three-fourths of Sweden's bedrock consists of primary rock, and primary rock is a very good material since it is very solid and has relatively low heat conductivity.

There are several types of borehole storage spaces, but they differ from each other chiefly in the way the interchanging of heat takes place, in how the water is sent down to them and how the heat is recovered.

There are open systems in which the water goes down directly into the rock. Another system has plastic tubes in the borehole, and a third is completely closed, with water which is carried down in U-shaped pipes of the immersion-heater type.

There has been a project called the solar energy project in the Swedish water power department since 1979. In that section, they are also interested in storage techniques.

In August 1981, the various borehole methods will be presented at a working meeting at Vattenfall, and after that there will possibly be full-scale experiments.

Test in Lulea

At the university of technology in Lulea, a test of small-scale boreholes was recently started. Since heat circulates in rock at a certain rate of speed, one also gets a distortion with regard to time when using small-scale boreholes. Thus, 24 days correspond to a year and 4 months are the equivalent of 5 years in the test.

"The power of the storage space we built is roughly equivalent to the annual heating requirements of 25 individual houses," says Bo Nordell, who is in charge of the project.

"Theoretically, a small-scale test should be exactly correct in its functioning.

"The storage space used inthe test is 21 meters deep and has 19 holes. The diameter of the whole thing is approximately 5 or 6 meters.

"Borehole storage spaces have other advantages," says Bo Nordell. "They do not take up as much space, are easy to locate and are also easy to enlarge, and furthermore the cost of constructing them is comparatively low."

9266
CSO: 3102/384

GOVERNMENT PLANS NATIONWIDE DEVELOPMENT OF DISTRICT HEATING

Duesseldorf VCI-NACHRICHTEN in German 17 Jul 81 p 8

[Text] District heat is one method of utilizing energy efficiently. Electrical energy and district heat together can take over a sizeable portion of the heating market in the next one to two decades and effect a noticeable rollback in light heating oil.

In spite of the necessity for conservation, according to Minister of Research Andreas van Buelow, the necessary funds must be found to push ahead with a major expansion of district heating and thereby to come closer to the goal of the "Away from Oil" policy. On 6 July, at the presentation of a preliminary study for a Ruhr area district heating design, Buelow announced that he would press the government to stress the expansion of district heating much more vigorously than before in the third updated review of the energy program.

In this context the minister also advocated investing more money for district heat in the review of the DM 4.35 billion energy conservation program. Thought should be given to government assistance to tie houses into district heat networks, which were not supported previously. According to his figures, district heat has so far only an 8-percent share of the heating market in the FRG. With a realistic design for expansion, up to 25 million standard coal unit tons in oil could be saved annually.

In the Ruhr, the largest area of industrial concentration in Europe, the "Community Association of the Ruhr Area" (KVR) thinks district heat expansion could be carried out in the next 12 years. As KVR director Juergen Gramke explained, the study, which has not been presented, shows the area ways to realize a safe, nonpolluting and economical supply of heat. A four-phase plan proposes overall regional planning, with particular consideration given to expansion of district heating. In order to agree on initial concrete planning steps, it suggests that all the companies active in the district heating market sit down soon at one table for a "Ruhr Area District Heating Conference."

Efficient use of energy means basically the replacement of energy through capital and/or investment, while making full and intelligent use of energy. The plants for heat distribution in particular are highly capital intensive in the area of providing district heating. So the use of district heating is limited to correspondingly concentrated areas. On the other hand, district heating meets the demands of an

energy policy for energy conservation, the use of coal and later nuclear energy, relieving the balance of payments and an improvement in environmental conditions in the cities. Compared with other methods of efficient energy use, district heating from heat generating stations in areas suitable for them shows the most favorable cost/benefit ratio of all.

In 1980 district heat achieved a hookup growth figure across the FRG of about 110 Megajoules/second (Megawatts, thermal). This is the equivalent of a heat requirement of about 150,000 WE (WE: a standard living unit of 70 ms^2). So district heat is meeting about 8 percent of the demand for heating and hot water. About 70 percent of this heat comes from energy-conserving heat generating stations.

As is known, the short- and long-term possibilities of district heating from heat generating stations were studied in detail from 1974 to 1977. It turned out that district heat can be tripled or quadrupled in the long term--but the problem of startup losses must not be overlooked.

Heat generating stations of different sizes should be located as close as possible to the consumer. If nuclear power plants as well are to be used later for city district heating, the distance from the areas to be supplied must be considered in adequate time.

The emissions-reducing effect of district heating is higher by far than the additional emissions from central heat generating stations with high smokestacks and suitable exhaust purifying installations. However, federal emissions protection legislation does not yet take this into account.

The construction and expansion of district heat systems presupposes corresponding planning by the companies. Under local designs for supply, medium- and long-term possibilities for district heating are to be worked out and put into practice as financing permits.

Financial incentives for the supplier companies to partially cover the startup losses and for the users to switch to district heat can substantially speed up the development of district heat regions. In addition, larger supplier areas can be steadily covered in this way.

The main emphasis in the future development of district heat will at first be on the cities which are already accessible to district heat. (Fifty-seven cities in the FRG already have heat generating stations.) The most cost-effective heat can be tapped off from electricity generating stations which have to be built anyway for reasons of economy. With a sufficient potential size and justifiable distances for transportation, nuclear power plants can also be brought in for district heating. There are clear political implications from this fact for the location of nuclear power plants.

In addition to tapping off heat from heat generating stations, the use of industrial thermal effluent is also important. In each individual case there must be an examination of the peripheral conditions under which a contribution to public district heating is possible.

The maximum distance for the transportation of district heat depends on several parameters--basically on the total output of the supplier area. The distance has grown further because of the rise in primary energy prices. Nevertheless, the emphasis in the continued expansion of district heat lies in the construction of local networks, which can later be developed into regional lines of supply.

Investments in the area of district heat, which were still about DM 350 million annually in 1976/77, have grown to about DM 1 billion annually in 1980. With additional measures for assistance, this volume of investment can certainly be doubled in a few years, but not trebled.

In spite of its clear advantages for energy economics and the national economy, district heating has to be attractive from the consumer's point of view. So the precondition for an accelerated movement to hook up to district heat is not administrative compulsion but suitable products on the market from the supplier companies.

9581
CSO: 3102/400

BRIEFS

WIND-POWER RESEARCH CONTINUES--The wind-power plant installed at Ouessant by Electricite de France (EDF), and which was supposed to generate 1000kW, failed in July 1980 after only a few hours of operation: one of its blades broke, destroying the installation within a few seconds. However, efforts to tame the energy of the wind have not been abandoned. The repaired Ouessant plant has been undergoing tests since last February near Bordeaux. EDF would like to test it for 6000 hours before deciding whether to rebuild it. In reality, such wind-power plants can operate without risks only with very reliable blades, such as are used in helicopters. A large contract is underway to ask such specialized companies as Aerospatiale to study the problem; these helicopter-type blades cost twice as much, causing the builders to hesitate. There are plans to install in Bretagne--probably at Lannion--a scientific test center for wind-power plants, which would be supported by the Scientific and Technical Center for Building in Nantes. The aim of the center would be to establish standards for these plants, so as to enable the launching into production of well known equipment, whose qualities could be easily verified. [Text] [Paris LE MATIN in French 19 Aug 81 p 32] 11,023

CSO: 3102/411

ROBOTS WITH SENSE OF TOUCH BEING DEVELOPED

Duesseldorf VDI-NACHRICHTEN in German 26 Jun 81 p 9

[Article: "Feeler Provides Sense of Touch for Robot"]

[Text] A branch of the German Aeronautics and Space Research and Test Agency, the Institute for Dynamics of Flight Systems in Oberpfaffenhofen, has been conducting research and development for several years on computer controlled robots with tactile feedback since the sense of touch is just as important as vision for many tasks. The objective of this work is to replace the human being with computer controlled robots in hard-to-reach or dangerous places, for example in space or at great ocean depths.

Previous effort was concentrated on programming computer controlled robots in the work room with a master computer which converted the objective cartesian coordinates into appropriate member angles and transmittted them to the robot's computer for execution. An additional focal point of this work was the testing of a 3-dimensional strain-gage force and moment feeler developed at the Institute for Dynamics of Flight Systems to provide the robot with a sense of touch.

The sensor consists of a base ring connected to a coplanar hub by 4 spokes. The hub is connected to a second ring by 4 columns. If forces and moments are introduced between the upper and lower rings, they produce, depending on direction, small mechanical deformations (compression or extension) in 2 or more spokes or columns. Eight pairs of tension strain gages (DMS) are bonded on in an array such that the change in resistance is a measure of the sensor's loading. The resulting electrical signals have to be amplified before they are fed into a matrix for computing the 3 forces and moments. The individual elements of the displacement matrix result from the mechanical properties of the sensor, loads are always applied in the same sequence so that instrumentation or loading errors can be detected immediately. Each sensor has its own individual matrix which is stored and which does not vary through time so long as the sensor is not mechanically overloaded; and this is prevented by strategically located stops. Sensors can be designed for a wide range of loads by simply selecting different dimensions for the components. Existing designs cover the load ranges 0.1 to 10 kp and 1 to 200 kp.

To date, the main problems which have been jointly studies with industry relate to assembly and joining processes (for example, the assembly of an oil pump) and grinding problems (cleaning of castings). This work showed that the sensor developed by the DFVLR is suitable for a variety of tasks, contrary to the widely held notion that a special sensor would be required for each new application. In addition the accumulated experience clearly shows that future robot generations can be made much more efficient by incorporating tactile sensors.

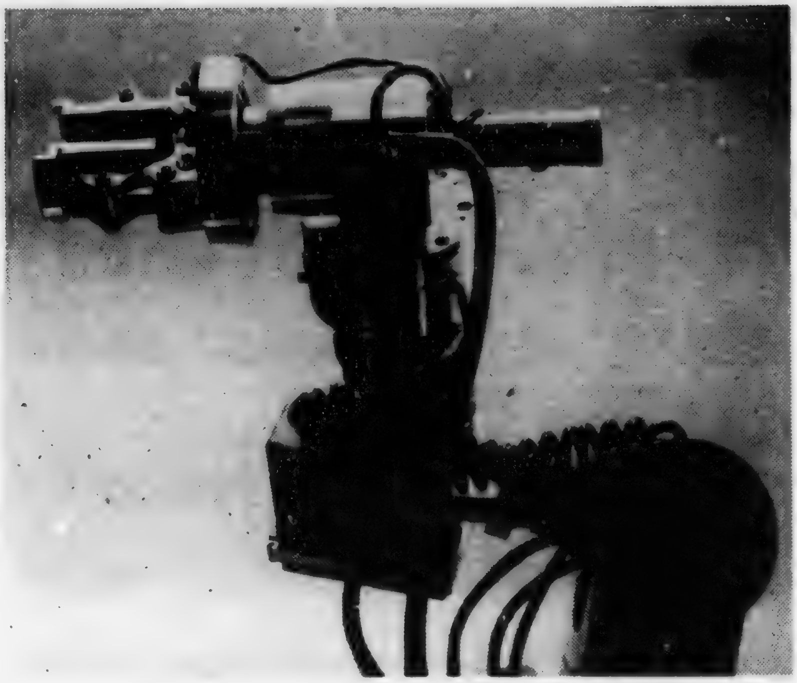


Figure Caption:

A 3 dimensional force and moment feeler is able to provide tactile sense for a computer controlled manipulator. It employs 8 pairs of strain gages.

9160
CSO: 3102/394

INDUSTRIAL TECHNOLOGY

RENAULT'S USE OF ROBOTS EXTENSIVE AT FLINS PLANT

Duesseldorf HANDELSBLATT in German 1 Sep 81 p 16

[Text] Frequent model changes in auto building leave the manufacturers no alternative to installing manufacturing equipment which can be converted quickly and cheaply at model changeover. The French Renault combine seeks its salvation in its own robots.

In the Renault factory at Flins, a robot paints the inside of an R 5 chassis as deftly as an elephant blowing water out of its snout. The agile device owes its dexterity to the fertile imagination of the French designers who--so it seems--draw their ideas from the animal kingdom. Like a snake, the robot's arm can flex in any direction. This capability is matter-of-factly referred to by the Renault engineers as "mobility in 7 axes", a feature lacking thus far in American and Japanese manipulators.

The chronic inclination of French engineers to want to attack a task differently than their colleagues in other countries has led to the development of a whole family of original robots at Renault. Also standing behind their do-it-yourself design is the Gallic compulsion to want not to become an American colony. On the other side of the Atlantic, the innovative activities of the French automobile builders are obviously being watched closely since, in October 1980, Renault formed a joint venture with the Ransburg Corporation--American specialists in surface coatings located in Indianapolis--for the development, manufacturing and distribution of painting robots (Ransburg 51 percent, Renault Industrial Equipment Engineering 49 percent).

Today, in the Flins factory 72 percent of the nearly 4500 weld points on the R-18 automobile are made without human hands. Automatic welding machines tailored for the particular type of auto are the main contributors to this high degree of automation, of course. Renault makes about 10 percent of the welds on the R 18 with robots. The robots which have been installed stepwise in the Flins factory since 1978 should demonstrate how they will prove out in the rough assembly-line environment. They are in operation for 15.5 hours per day. Pierre Pardot, director of automation engineering, lists the availability of his 30 mechanical slaves at 99 percent; 99.5 percent is targeted.

If the application of robots in the production of the R 18 can still be regarded as a prototype operation, this will not be the case in the new Douai factory. In manufacturing the "142", today's name for this factory's future product, the degree of mechanization will be increased to 95 or 96 percent; and this time robots will take over most of the work.

The production engineers will naturally incorporate in the new factory the clever details tested at Flins. For example, automatically-read markings on the stepwise-evolving chassis tell the robots what programs are required for the next manufacturing step. The ability to vary the tasks of these untiring mechanical helpers by

program selection solves not only technical problems but also creates extraordinary flexibility in vehicle output. If more autos per day are required from the assembly line, then the robots--they also have their limits--simply weld fewer points per chassis. What is left undone will be done by hand by human workers. In this manner, production variation of up to 50 percent can be accommodated.

It is no longer possible for man to do all the jobs a robot can do. For instance, an "iron welder" holds a spot-welding gripper weighing up to 80 kg. With no effort, the robot can reach this heavy gripper around the door frame and make a weld on the floor plate in the center of the vehicle. A gripper opening of 60 to 70 cm obviates expensive, highly mechanized tools which cannot be readily reworked at model change-over. So that a robot with such a heavy gripper does not spend too much time opening and closing its gripper, Renault engineers have chosen an 8-step variation in this additional controlled "axis." Part of the required gripper adjustment is made as the robot moves the welding gripper from point to point, and the final adjustment is made at the terminal point.

Having in-house capability for manufacturing machine tools made it easy for Renault to decide to build its own robots. Today, the robot development team numbers 130 people, 70 percent of whom are university graduates. Pardot points with pride to the high know-how of his troops. An example of their capability is a prototype of a seeing robot which can pick up the topmost of a pile of drive shafts. However, Renault's production robots come from Acma-Criebier in Beauchamp. This subsidiary of the auto concern has 350 employees and logged sales of FF 150 million in 1980, 60 percent of which was in robots. To date, 220 units have been delivered with 60 percent staying at Renault. Acma is consciously aiming at diversification into non-auto industries. The robot program extends from electrically powered devices with an 8 kg payload (DM 130,000) up to hydraulically powered versions with a payload of 80 kg (DM 220,000 to 240,000). Depending on the application, the robots operate from an overhead frame, a pedestal or a vertical column, like an ape in a tree.

9160
CSO: 3102/403

INDUSTRIAL TECHNOLOGY

FRENCH MACHINE TOOL INDUSTRY TO BE RESTRUCTURED

Paris ELECTRONIQUE ACTUALITES in French 4 Sep 81 pp 1,3

[Article by G. Bidal]

[Text] During the summer, the government tackled the difficult topic of the machine-tool industry (MO), and at least indirectly, the electronics industry is concerned by the technologic changes which will be the true stakes of a restructuring which everyone deems inevitable. Indeed, automation appears to be the only chance for the survival of the French MO. At least one of the various poles of this restructuring should be organized around the idea of flexible shops, whether by user sector (automobile construction, for instance) or by product (machining centers in particular).

France wants to pick up the challenge of industrial automation. The statements of the prime minister as well as those of the ministers of industry and research have been clear in this respect. And one of the six think-tank sector-commissions being instituted by Mr Dreyfus will be devoted to robotics.

Although the present circumstances appear to be less gloomy in the automation industry than in other sectors of electronics--particularly in the wake of several gratifying export contracts: subway and train in Egypt and Brazil, electrical equipment in Venezuela and South Africa--the major problem is MO. This sector, which has had a turnover of 2.5 billion in 1979, is sick: it lost 7000 jobs (it currently employs 19,000 people) and one-quarter of its production in five years. The low investment in this very scattered sector (three-quarters of the 180 French MO businesses are small and medium-size enterprises) has not allowed it to undergo indispensible changes, beginning with a symbiosis with electronics which has made Japan's success.

Let us make no mistake, the electronics world cannot remain indifferent to the drifting of the French MO. First of all because several electronics companies have an interest in it (such as CIT-Alcatel with its Graffenstaden subsidiary, Sagem, or Matra with Manhurin), but also and mainly because a strong French automation industry cannot be imagined without the support of a lively MO sector. As an example, the French builders of light-weight robotics (Afma, Climax, Sormel),

although unquestionably well positioned in Europe and even in the world, have had their impetus stemmed by the absence of investments from MO, whereas one of the keys to Japan's success has in fact been the offer of machines already equipped with loading arms.

Today, everyone agrees that the main chance for survival of the French MO is in top of the line machines for flexible shops.

The Line Case

The refloating of Line, the second largest in the French MO, in the form of a financial support of 360 million francs (in equal parts from banks and the authorities), has been only a stopgap measure. At the request of the President, the complete MO file is in the hands of Mr Dreyfus, minister of industry. Four think-tank groups have been instituted, one on special and heavy machinery, another on catalog machines, a third on research (automation), and the last on trade policy.

Several restructuring plans are being considered: by products, with heavy machines on one hand around a Line-TMI-Forest pole, and machining centers-flexible shops (around Renault MO); or by sectors of activity, with aircraft builders (Berthiez, TMI, Jordan) and the automotive industry (again around Renault). The question still remains whether restructuring will occur within the MO sector or whether connections will be made with outside enterprises. The automotive industry is a favorite, but electronics should have something to say in all this.

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AUDI PROTOTYPE MAKES WIDE USE OF LIGHT METALS, COMPOSITES

Turin ATA in Italian May 81 pp 316-320

[Article: "Audi Quartz Pininfarina"]

[Text] The "Quartz" comes within the framework of the programmed research that Pininfarina has set for itself for some years now in order to cope with the subjects connected with the evolution of the automobile.

Many factors have influenced and continue to influence the technical and stylistic conception of the automobile, but the energy aspect has prime importance today. Decrease in fuel consumption depends not only on the characteristics of the mechanical organs but also on the design of the body, and in this sector, Pininfarina has made and will continue to make its contribution. The new generations of bodies will have to be more aerodynamic and lighter.

The aerodynamic aspects are part of the study for an ideal form carried out a few years ago on behalf of the CNR (National Research Council).

The considerations connected with a "light" vehicle that achieves the best ratio between weight and power have now been tackled with the "Quartz," through an original body study carried out with new materials that current technology is already making available or that will be available in the near future, coupled with a basic mechanical design that proposes pioneering approaches that are relatively simple and light for a four-wheel-drive car.

A year ago, at the Geneva Salon, Audi presented a new item of special interest: the Audi 4, a four-wheel-drive sport coupe specifically designed for rally competition.

The four-wheel-drive system in the Audi 4 has been built by relatively simple and light technical solutions that Pininfarina considered particularly suitable for the body-design base that it had in mind to construct.

For this design, Pininfarina made use of a whole series of new light materials carefully selected from among those produced by the most advanced technologies used in the aeronautical sector in particular.

The originality of the design lies also in its transferring these materials from the aeronautical to the automobile sector--not only to competition cars only, though, but also to mass-production autos.

Study of the application of light materials in the atuomobile industry has currently become basic, because of the importance of vehicle weight for fuel consumption.

In the United States, for example, 1985 has been set as the date by which automobile fuel consumption must reach an average of about 11.7 km per liter.

Therefore the weight-to-power ratio--an index of the sport performance characteristics of a car--must today be considered also as a fuel-economy factor.

The relation between fuel consumption and weight depends on the way in which the so-called "light" solutions are introduced: it is not a matter only of replacing materials with others that are less heavy, but also of going in the direction of different design philosophies, suited to the new materials.

We will have an initial phase in which the gradual replacement of the normally used materials will lead to hybrid bodies--composed, that is, of elements of different kinds.

This prototype is intended as a practical example of the use of light materials, metallic and nonmetallic.

The concept inspiring the body line was to obtain a dimensionally compact form--therefore one that is light, of simple design, but strongly characterized.

The result is a body that has a "groove" around its perimeter, ideally dividing the upper part from the lower.

With this "groove" is also associated the function of conduit for the internal aerodynamics of the engine compartment: air enters in the front through the slit in the forward part of the "groove" and is discharged in the zone immediately behind the front wheel wells.

Another characteristic of the car is the total absence of protrusions: the windows have no external posts; the door handles are concealed behind door windows; the front and rear lights are recessed into the body form.

In line with the approach taken, the dimensions of the optical units are minimized.

The headlights, the result of a study by Carello, use elliptical optics and are greatly reduced in their frontal dimensions, while achieving performance characteristics that are entirely comparable, if not superior, to those of the most powerful traditional headlights. Their lenticular appearance and their placement characterize the front part of the car.

For reasons of compactness, the rear has minimal bulk, yet sufficient to provide a sizable luggage compartment for this kind of car.

Other characteristic elements are the external rear-view mirrors, which also provide for dynamic ventilation of the interior. When automobiles were fitted with wing windows, internal aeration was provided for by the fact of their mobility. Today the movable wing window has disappeared, mainly because of the regulations about visibility, and the new rear-view mirror patented by the SAIAG [expansion unknown]

performs the same service in a modern fashion. The wind-tunnel tests run have confirmed its validity.

Used air is exhausted from the interior through a slit formed by the special design of the rear side window. The car's interior has been designed in the spirit of the approach taken, using light materials and coverings in a design characterized by maximum simplicity and functionality.

A rail of section similar to that of a handrail runs laterally along the doors and the rear sides and functions as armrest, support grip, housing for controls. In the front, this rail develops in such a way as to become the dashboard.

The characteristic feature of this dashboard is the absence of protrusions: the instrumentation is recessed and covered by a special screen, transparent from certain angles and opaque from others, so that it provides maximum legibility of the instruments from the driver's seat and eliminates annoying reflections of the instruments on the windshield.

The glove-compartment door holds the on-board computer, and with the door open, presents it in such a way that it can be used like a keyboard.

The on-board service functions include also a secondary instrumentation comprising two lights indicating locking of the differentials--the control is located on the central console--and four lights to signal insufficient tire pressure.

The passenger arrangement is that of a 2 + 2, with good leg room for the rear passengers. The fuel tank, of an original T shape, is under the floor and between the rear seats, and its capacity is about 85 liters.

This approach, in addition to providing a safe position, gives a geometrically very usable floor area, with a useful volume of about 300 liters. With the backs of the rear seats capable of being lowered flat separately, the load volume becomes about 800 liters.

Light Materials Used

The composition of the prototype is as follows:

Outside:

--front and rear bumpers of Kevlar-honeycomb-Kevlar sandwich structure;

--hood, roof panel and side panels of aluminum;

--door panels of steel-polypropylene-steel sandwich laminate;

--rear window of polycarbonate;

--rear-window frame of carbon fiber.

Inside:

--seat frames and steering wheel of carbon fiber;

--upholstery covering of parachute cloth.

Aramidic Fibers - Kevlar

For about a decade, this particular aramidic fiber has been used in a very wide range of industrial applications, and more recently it has been used in sports cars in order to obtain very light bodies. It has very low volumic mass (1.45 g/cm^3) and high tensile strength (3,617 N/mm^2).

The principal characteristics of Kevlar can be summarized as follows:

--the highest strength-to-volumic mass ratio of all fibers;

--rigidity-to-volumic mass ratio lower than graphite only;

--excellent intrinsic strength;

--good thermal stability and resistance;

--good resistance to chemical and atmospheric resistance;

--high vibration-damping capacity: 8 times higher than steel and 4 times higher than that of the other reinforced fibers.

On the prototype, Kevlar has been used in the construction of the front and rear bumpers, and in particular, as the outer surfaces of a sandwich with honeycomb panels inbetween.

The whole is characterized by very limited weight and high compression strength; the bumpers are therefore capable of sustaining strong impacts without deformation.

Honeycomb

This particular configuration, whether of aluminum or of aromatic-polyamidic paper, is widely used in the aeronautic and aerospace industry, since it makes it possible to obtain sandwich-panels with the following characteristics:

--very high strength-to-weight ratio;

--very high rigidity-to-weight ratio;

--high compression strength;

--high fatigue limit;

--good heat resistance and good heat-range tolerances;

--acoustical-absorption properties;

--high ratio of exposed surface to volume occupied.

Depending on the type of cellular configuration, it is possible to make the material take special curves and bends, such as spherical caps, flexes, cylindrical surfaces.

Indeed, the core of the bumpers is obtained by shaping honeycomb panels of negligible weight to the bumper cross-section.

Carbon Fibers

Carbon fibers, in the form of fabrics or as elements obtained by poltrusion, are gradually arousing growing interest in the automobile field. The explanation is

simply that with equal mechanical strength, it is possible to achieve weight savings on the order of about 70 percent as compared with steel and about 33 percent as compared with aluminum.

The characteristics of:

--low volumic mass (1.75 g/cm^3);

--high rigidity;

--resistance to corrosion;

--fatigue-stress resistance;

--thermal stability;

--low electrical conductivity;

--low X-ray absorption;

make possible a wide range of applications on automobiles--mechanical elements such as drive shafts, engine mounts, springs--or body elements such as internal bracing, bumpers, door panels, hoods, etc.

The prototype offers, as examples of possible applications, the rear-window frame, the seat frames and the steering wheel, made of fabric of carbon fiber stratified with epoxy resin.

Metal-Plastic Laminates

An innovation in the field of light metallic materials is represented by the metal-plastic laminates, in which two thin laminas of steel or aluminum are joined to a polymer core, with the whole forming a structure whose properties are comparable to integral steel or aluminum.

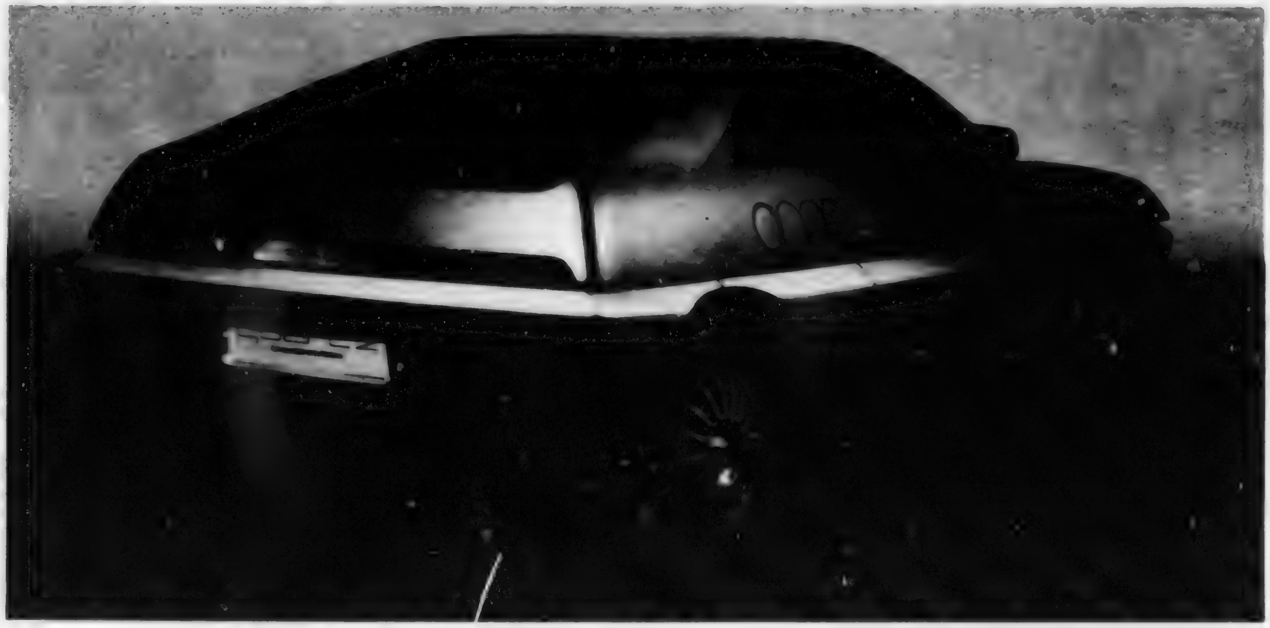
The product in question makes it possible to reduce weight by about 50 percent as compared with an equivalent structural element of sheet steel; therefore, especially as regards their cost of purchase and use, the metal-plastic laminates are valid substitutes for sheet steel. Moreover, the thermal and acoustical insulation characteristics offer considerable secondary benefits in automobile-building.

The forming of this type of material requires bending machines and presses of lower power for the same thickness; therefore it is to be noted that substitution for a standard sheet, in terms of strength, is obtained with a total sandwich thickness greater than that of the reference sheets.

In any case, the quantity of steel used, by weight, is still less.

A very important role is therefore played by the plastic core, and the performance characteristics of the laminate depend on it. It has been observed that nylon cores seem to offer better characteristics of bending strength, resistance to denting, recovery of elasticity, impact resistance, especially if joined with aluminum.

From the point of view of body assembly, a "disadvantage" of the metal-plastic laminates--though one that can easily be overcome--is the impossibility of making welded joints. For now, riveting, calking or bolted elements have to be used.



This last-named approach has already been used for rear fenders for some time, while the joints of the preceding types are normally used for doors and hoods.

In line with this, the prototype's doors have been made of steel-polypropylene laminate, demonstrating its drawing characteristics with the special section of the car's side.

The thickness of the laminate used is 1 mm, formed of two steel laminas of 0.2 mm and a 0.6-mm polypropylene core--that is, a laminate 60-percent plastic.

Aluminum

Aluminum is the metal material with the lowest volumic mass (2.7 g/cm^3), and it has always been widely used for purposes of lightness: in aeronautical construction and for automobiles, it has no rival among metal materials.

The aluminum alloys are of various types, depending on the percentage of the added elements, such as copper, silicon, magnesium and zinc.

In this way, alloys are obtained with particular use characteristics.

For the engine hood, the roof and the side panels, the "6000"-series alloy was used, the characteristics of which can be summarized as follows:

--good drawing quality;

--fair weldability;

--optimal corrosion resistance;

--yield-point and maximum tensile-stress values comparable to those of steel.

Polycarbonate

In the prototype, the rear window has been made of polycarbonate, as an example of substitution for glass.

In this way a weight-saving that can be estimated at about 50 percent is possible, as is shown by the following table:

Thickness (mm)	Polycarbonate: kg/m^2	Glass: kg/m^2
4	4.8	9.6
5	6.0	12.0
6	7.2	14.4

In addition to this there are characteristics such as:

--good mechanical strength within a wide range of temperatures and physical conditions;

--thermal-expansion coefficient better than that of glass;

--heat insulation higher than glass;

--excellent transmission of light;

--excellent filtration of infrared rays and especially of ultraviolet rays;

--excellent resistance to chemical agents;

--good deadening of sound;

--good abrasion resistance;

--low volumic mass (1.2 g/cm^3).

11267
CSO: 3102/392

TRANSPORTATION

DEVELOPMENT OF AUTOMATION IN BODY MANUFACTURING AT FIAT

Paris INGENIEURS DE L'AUTOMOBILE in English Jun-Jul 81 pp 48-52

[Article by M. W. Vignale, director of manufacturing, Fiat factory, Cassino]

[Text]

In the broad field of automation, and more particularly in the field of flexible automation, the subjects described in this presentation regard some of the most significant technological implementations made hitherto at Fiat Auto.

They regard body manufacturing operations, i.e. that portion of automobile manufacturing which has originated probably the toughest problems for the Company, both for the concentration of actions by the Unions, and for the immediate interaction with market phenomena.

In our body manufacturing, if we look at things in chronological order, we can by and large say that automation has evolved through the following steps :

- before 1968 the main objective was to eliminate with automation those human jobs that were either dangerous or unhealthy, taking advantage from the opportunities offered by a constantly rising production and the foresight of payoff through scale economies;
- between '68 and '73 the technological effort pursued, by taking into consideration the claims evidenced by the contestation, but meanwhile also to succeed in producing not withstanding the persisting conflictuality.

From '73 till now, in order to cope with conditions of market saturation featuring uncertainty of time continuance and abrupt jumps in quantity and mix of the demand, our Company has introduced those technological innovations which could contribute to recover some margins of flexibility that had been lost as an effect of the contestation.

Today, after breaking into the Eighties, the model of a rigid production line delivering identical products throughout several years is being gradually substituted by a model of marked flexibility, according to which every productive unit (for instance every shop) can deliver diversified elements to different productive units downhill, according to schedules of quantities and mixes that can vary between ample limits.

Besides this, there is a trend to conceive and implement production toolings that can be more easily modified for future car models.

In other words, flexibility has two aspects; one is the capacity to produce at any time more models in variable ratios, the other is the capacity to convert the tooling (rapidly and with moderate expenses) in the event of models changeover.

The body and assembly operations can be subdivided into three main areas each one characterized by peculiar type of work and environment : the body-in-white, the painting, and the final assembly.

Let us now go into some detail within the body-in-white area.

Until 1960-1965, all over the world the welding, which is the prevailing activity in automobile body-in-white fabrication, used to be executed by hand.

The parts to be joined were clamped on captive fixtures, fixed on the shop floor or moving along a line depending on the required hourly production and consequently on the degree of job partition among the workers.

The major assemblies composing the body were then welded together in a bigger fixture with three dimensional extension called the Main Assembly Jig.

Mechanization and conveyor transport were used for handling the heavier or the bigger stampings or subassemblies, but all of the welding spots were applied manually, with considerable worker's effort in handling the heavy suspended gun, however counterbalanced it could be to ease the vertical displacements.

The environment was all but comfortable, the aerial conveyors and the suspended transformers with their cables and cooling pipings prevented the natural light from arriving at the working posts, the noise level was high due to the impacts of steel parts on their supports, to the intermittences of opening and closing of air-operated guns and the continuous movement of conveyor chains.

In 1961, on the occasion of tooling up for the new model car 1300/1500, Fiat automated the welding of the biggest subassembly composing the body, i.e. the body floor and trunk floor, complete with the side sills, the cross members for stiffening and the attachments for the power train and suspensions.

This is a machine built on the principle of the mechanical transfer lines, a certain number of multiple welding stations between one loading and one unloading station, mechanized transport between stations, mechanized workpiece clamping in each station.

The human task here consists of positioning the loose parts on the loading station, welding becomes the machine's task.

The need for qualified labour to do the maintenance is increased.

The machine improves the quality and the consistency, at least for this most important assembly group.

The rigidity was the main drawback of such type of machine, as it was very soon experienced.

Nevertheless, the constructive concepts of the first transfer welder are extended and applied for the subseguent toolings dedicated to models 124, 128 and 127.

Not only the floor, but the entire underbody, the unisides, the roof, the doors and hoods, are all assembled on multiple spot transfer welders.

The worker is so liberated from a good deal of the welding that comes prior to forming the body as a three-dimensional closed shell. But the inconvenience of rigidity is enhanced : the welding machines are dedicated, each one being tied to a specific model of car, any design change made on the body requires long production holdups for machine modification, and at the end of a model's life hardly anything, more likely nothing at all can be saved for further use.

The Major Assembly Jig remains the traditional one, with four or five workers loading the component assemblies and clamping them in the correct relative position, then tackwelding manually one to another.

The technological situation described applies to the end of the sixties, while the more lively labor moves, among many items, raise those of work organization, of monotony, of the environment.

In 1972, for the brand new Cassino Plant, new tooling is conceived and built for model 126.

Mechanization in the body-in-white area extends itself to the Major Assembly Jig, which is now made to effect not just the tacking, but nearly the complete body welding.

Thus a twofold target is reached, to save the worker one more arduous stage and to improve the consistency of geometry from one body to another this being a prerequisite to obtain those close tolerances which will be necessary for a correct application of robots for weld completion after tacking.

The Automatic Assembly Jig for the 126 has its defects too, it is a congested and complex machine, too many transformers and electrodes are concentrated in its two stations, maintenance will originate problems due to the slowness of every intervention, which involves downtime for the entire line.

More and more is felt the need for inprocess buffer storages.

In 1972, at the same time when the 126 Automatic Major Jig is adopted at Cassino, in the Mirafiori Plant the first large scale application of robots starts its operation. The installation includes 16 robots,

and the task is the completion welding of bodies after their tack-welding on a traditional manual Major Assembly Jig.

The evolution continues and brings in 1974 to the tooling for Model 131, which is duplicated at Mirafiori and Cassino with some minor differences suggested by the different production requirements.

This is an important milestone not only for the type of machinery, but also for the layout, and has remarkable effects on work organization.

Wider spaces surround the machines, the lighting is improved, the ambient moise level reduced.

The Major Assembly Jig is split into two stations, and there is already a beginning of flexibility, at Mirafiori for the 4 doors body and the two doors in casual sequence, at Cassino for the four door and the Station Wagon.

The robots are applied with no more doubts about their efficiency, which has already been proven by two years of excellent performance on the 132 Model.

The system of conveyance of the bodies through the Major Assembly Jig and the robots contains a substantial innovation for the quality and the uniformity of the product : the pallets.

Each body is clamped underneath at the beginning, and is kept clamped throughout the completion of welds, in stead of being clamped and unclamped at each station. This avoids the distorsions otherwise induced by the coaction state into the partially welded bodies.

1978. The experience acquired on welding robots, on pallets for the entire body, and on process computers have made the time mature for implementing a body-in-white installation of entirely new concept to which the name Robogate is applied. Such installations have been set up in the two plants of Rivalta and Cassino for the Ritmo model car.

Let's for the moment synthetize the main features, to begin with the name Robogate which is motivated by the fact that the welding operations are done by robots and that in the tack-welding stations the geometry of parts positioning is assured by fixtures having the shape of « Gates ».

Material handling is effected by means of self moving carts called Robocarriers.

The system can assemble more variants of the same model body or even different body models.

A detailed description of the Robogate system operation will be given later, after a hint to a further development in the chronological order.

In 1979, ont the occasion of the tooling for the Panda model, a robotized Major Assembly Jig is installed at the Termini Imerese Plant.

In such installation, the tack-welding operations on the car body are made along a palletized transfer line. Such solution, although offering a lower degree of flexibility than the one obtainable from a transport system based on Robocarriers (as in the Robogate) permits to reduce the total area and the coast substantially.

The body arrives at the Major Assembly Jig with only toy-tabs bent to hold together its main assemblies, and is deposited on a pallet.

The step by step transfer mechanism carries the pallet into the tack-welding station: here clamping devices by forcing the toy-tabs, give the fine location in space of the above said assemblies, after which the tack welding takes place.

The station structure is composed of supports for :

- the vertical robots;
- two swinging gates equipped with clamps for one model body;
- a second pair of gates equipped with clamps for another model, which if necessary can be completely different from the first.

The change of gates is done by quick – shifting them forth or back alongside the direction of the line, the shifting occurring, if required, during the time the next body is carried into the station.

This system can therefore weld different models of bodies, presenting themselves in random sequence at the tack-welding station. If the different models require different pallets, it will be necessary to install by side of the line a pallet warehouse with which the line can interchange pallets; each interchanging operation will have to occur within the cycle time of the line.

In the stations following tack-welding, completion welding and chassis number engraving are carried out. The operations

foreseen by the system start with one loading station and ends with one unloading station. The system is integrated with a buffer storage of welded bodies, which permits to continue production in the event of a line stoppage.

The system of Termini Imerese was adopted because of the following advantages :

- production flexibility;
- improved working environment;
- limited production losses.

ROBOGATE

As already mentioned, the name Robogate has been given to a specific type of system, which operates in the body-in-white shop, and has been used till now for the body assembly of the Ritmo car in the 3-door and 5-door versions and for the fabrication of the uniside subassemblies for the same model car.

The most important novelty of the Robogate is this : unlike the system previously adopted, it has a great flexibility (in itself it would have even complete flexibility, which on the other hand would be prevented by other areas of manufacturing). In fact the Robogate is capable of handling at any time two different model cars at fixed total hourly output and variable partition between zero of the first model and zero of the second model.

Moreover, the Robogate will require only a partial adaptation to allow for new models to be produced.

Flexibility therefore means also that the system (in the majority of its structure) is going to have a longer life than the models that it produces.

This is important if we bear in mind that today, in all countries, the body styles tend to evolve more rapidly than in the past.

One of the objectives that have been pursued in creating the Robogate has been the implementation of a welding system that does not have to be dismantled when a model is changed, but only adapted in some of its parts, thereby requiring reasonably short changeover time and limited expenditure.

From the viewpoint of the product, two distinguished Robogate system have been designed, although both rest on the same general operating principles : a Robogate for uniside subassemblies welding and Robogate for body assembly welding.

Let's now consider the fundamental components of the general Robogate module, and describe the machines and their purpose.

The welding spots, as said before, are applied by robots, and these are organized in groups, each group containing a minimum of two and a maximum of 5 robots.

A group includes all the robots that do their job at the same time on the same body.

Each group defines one welding station and the appearance of it can be described as a porch with upright pillars topped by horizontal beams with overhang, forming altogether a parallelepiped having its the three dimensions about three times those of a car body.

Every robot presently has in its memory the two work programs which have to be executed, depending whether the station becomes occupied by the 3 or 5 door version of body (or uniside).

A Robogate module is composed of several stations. Each station can be compared to a work island, because each station is allowed to work at a pace which is not necessarily synchronized nor phased with the uphill or downhill stations.

This independence is consented by the new system of work transport, based on the use of Robocarriers, both for the unisides Robogate and for the body Robogate.

The Robocarriers have two pivoting drive wheels, driven by electric c.c. motors, and two pivoting idle wheels; the motors are supplied by accumulators that are recharged every night.

On each carrier a hydraulic device provides lifting the pallet in every station and depositing it onto calibrated rests for correct location relative to the robots. The carrier has, on all four sides a rubber bumper, connected with current cut-off switches, and this provides safety in case personnel inadvertedly walks or stands on the trajectory of the carrier.

The control is obtained by guidance wires embedded in the floor. The electromagnetic field around such wires is sensed by the carrier antenna and interpreted as a command depending on its frequency distribution.

Conversely, the robocarrier signals its presence at determinate points on its possible trajectories.

Several local control units are disseminated in appropriate points in the shop, and each of these connects one portion of the transport network to the central control system (Digital P.D.P. 11 minicomputer).

The central control unit, among its other tasks, takes care of controlling the traffic of the Robocarriers (which are approximately 25 in each module), by providing or denying power supplies to the local control units, avoiding carrier collisions at network intersections, preventing traffic jams from originating, halting the carriers when necessary and restarting them as soon as the situation permits, or deviating them along alternative trajectories.

All this occurs in the maximum quietness (so quiet as electric vehicles can be).

The unisides in one case and the bodies in the other case do not rest directly on robocarriers.

The support is arranged to occur by means of an intermediate structure, the pallet which has the purpose to sustain and clamp in the correct position the group of subassemblies which is placed upon it, for the entire duration of the process in the various stations. The base of the pallet on the other hand has a universal configuration, so that any pallet may rest upon fixed positioning pins which find themselves on each Robocarrier.

It is foreseen that in the future our Robogate systems will handle bodies of different shapes and sizes, so that different pallets will be required. The systems are therefore arranged so that they may be equipped with warehouses of pallets, capable of automatically exchange pallets on the standard robocarrier, when this is requested by variations of the mix to produce.

Referring to the case of the body, the four subassemblies that compose it (underbody, R.H. and L.H. unisides, roof) are kept together fairly well by the pallet. However, before starting to weld, the four subassemblies (which initially are only toy-tabbed with one another) are clamped in a geometrically positive way. This is the task of the swinging gates which, prior to tack welding, automatically swing closed against the body and actuate their clamp.

At this point the robots apply the first 70 or 80 spots the ones that begin to give a certain rigidity to the body shell, the so-called tack-welding spots.

The change of the car type requires the replacement of the gates during the cycle time and controlled by the computer.

In the subsequent stations, where the gates are not required any more, all the necessary completion operations are done, till the complete working program is performed.

The basic cycle for the material flow in the system starts from the loading station, where the parts are automatically deposited on an empty pallet arrived at this station on board of a Robocarrier.

The Robocarrier is then sent to the various stations of the module, by keeping into account the requirements of the loaded module.

At the end the Robocarrier, carrying the welded body, is despatched to the unloading station, where an elevator automatically picks up the body and sends it by conveyor to the subsequent operations. The carrier remains with the empty pallet and can then start another cycle, by moving itself into the loading station.

The operations which are performed within the Robogate system, like the weld spots applied at any station or the displacements of any Robocarrier from one stop location to the next stop location, are all effected under control of several local control units, everyone of which covers only a certain type and a certain quantity of activities.

Coordination of all these control units is then assigned to a fairly powerful computer, which supervises all that happens in the Robogate module, that is :

- it programs the sequence of the work operations;
- it distributes the resources of the installation;
- it starts, controls and verifies the good result of operations;
- it keeps and continuously updates the situation of the system and the various statistics on production date and efficiency of the system.

To obtain all this, between the installation and the computer a great flow of information travels continuously under the form of electric signals.

The computer through its terminals (teleprinters and C.R.T. displays) communicates or rather dialogues with the operative and the maintenance personnel.

The computer gives or conversely receives all the useful news, above all it signals when human intervention is necessary, which is the case only in the event of a malfunction of some component of the installation, besides of course the necessity of human control to start and to stop the activities of a working shift and to recall statistics on the production.

One more feature we would like to mention; the system, besides the traditional process controls, provides a very strict and unbiased type of quality control, as it is an automatic control; the quality of every spot weld applied is checked and if defective is monitored.

In such cases it is possible to timely repeat those welds which in the first run have not resulted successful.

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TRANSPORATION

ALL-PLASTIC BICYCLE FORESHADOWS FUTURE AUTOMOBILES

Stockholm DAGENS NYHETER in Swedish 2 Sep 81 p 12

[Article by Peter Sandberg]

[Text] In 1977 Volvo began thinking about manufacturing a compact car with large portions made of plastic. The first results from this project were presented Tuesday in Gothenburg--a bicycle.

The company that developed this plastic bicycle, Itera AB, believes it will soon be possible to turn out 300,000 bicycles annually plus a large number of plastic wheels for other bicycle manufacturers.

It has long been a dream to produce a bicycle of plastic. A plastic bicycle would be guaranteed maintenance-free and could be produced with less labor expenditure per bicycle produced. It is also possible that a plastic bicycle could be lighter than a conventional bicycle.

Present bicycle production also includes skilled craftsmanship, for example wheel construction, which causes bottlenecks in production.

Several attempts have been made to manufacture plastic bicycles, but none have made a breakthrough on the market. Now there will be a Swedish attempt.

Injection Molded

What makes this development technically feasible is the rapid development of "composites," i.e. fiber-reinforced plastics. It is now possible to produce light and strong parts made of injection-molded plastic. Composites are used, for example in airplanes and spaceships where precision and reliability are required.

For this reason, it is perfectly natural that several years ago Volvo began studying the feasibility of manufacturing an automobile based on composite technology. It was found that this would be possible some time in the future.

Volvo employees active in this project found that several hundred other products could be made of plastic. The most exciting possibility was the bicycle. For this reason, Lasse Samuelsson and others continued on their own time to develop the

the bicycle project. In 1980 he and marketing executive Jan Olsson, among others, left Volvo to form Itera AB and continue development of the plastic bicycle.

"We worked with the 'Volvo model' and took the best resources as they were rather than designing them ourselves," Lasse Samuelsson said.

In this way, the finished bicycle has become a combination of plastic from Beyer, bearings from SKF, taillights from Arbetsbelysning AB, gears from Sturmey Archer and Simple, brakes from Weinman, etc.

The bicycle will be produced completely in Sweden, however, at the Milhelmina plast AB.

What type of product is this then?

Well, it is a bicycle whose frame has the appearance of a moped. The handlebars are plastic, as are the package carrier and the frame. The light is battery operated and built into the frame. The taillight has diode lamps instead of light bulbs.

The wheels are made of plastic and have eight strong spokes.

Several models are available with 1, 3, 6, or 12 gears. The bicycle is designed for the international market, as seen by the absence of a foot brake. Instead, it has hand brakes on both wheels.

The tires are standard 27 x 1/4 inch.

A test ride indicates that it is rather comfortable to drive, once one is accustomed to the slight springiness of the handlebars.

Full production will begin after the new year. Retailers are being contacted now and the production capacity is about 300,000 bicycles per year, which is just over half Sweden's bicycle sales. So far, 50 to 70 million kronor has been poured into the project. The money has come from STU (National Board for Technical Development), loans from the PK Bank (Joint Post Office and Commercial Credit Bank), and other sources.

If all goes well about 140 jobs will be created at Vilhelmina plastics, which is presently operating at a loss, even though only 11 employees will be involved initially.

The price of the bicycle will be 1,300 to 2,100 kronor, depending on what equipment is included. This will mean competition with conventional, high-quality bicycles such as Monark-Crescent. Marketing is aimed at the Nordic countries and, after a year or so, the rest of Europe.

It is not clear whether or not this product will make a breakthrough on the market. The plastic wheel, however, should be a big seller, since it requires no adjustments, is corrosion-free, and can be used on any bicycle.

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